

ISSUE 2

STANTEC

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ENERGY & RESOURCES ADVISOR



THE DIGITAL ISSUE

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Digital Twinning the Panama Canal

A model to enhance project delivery and performance



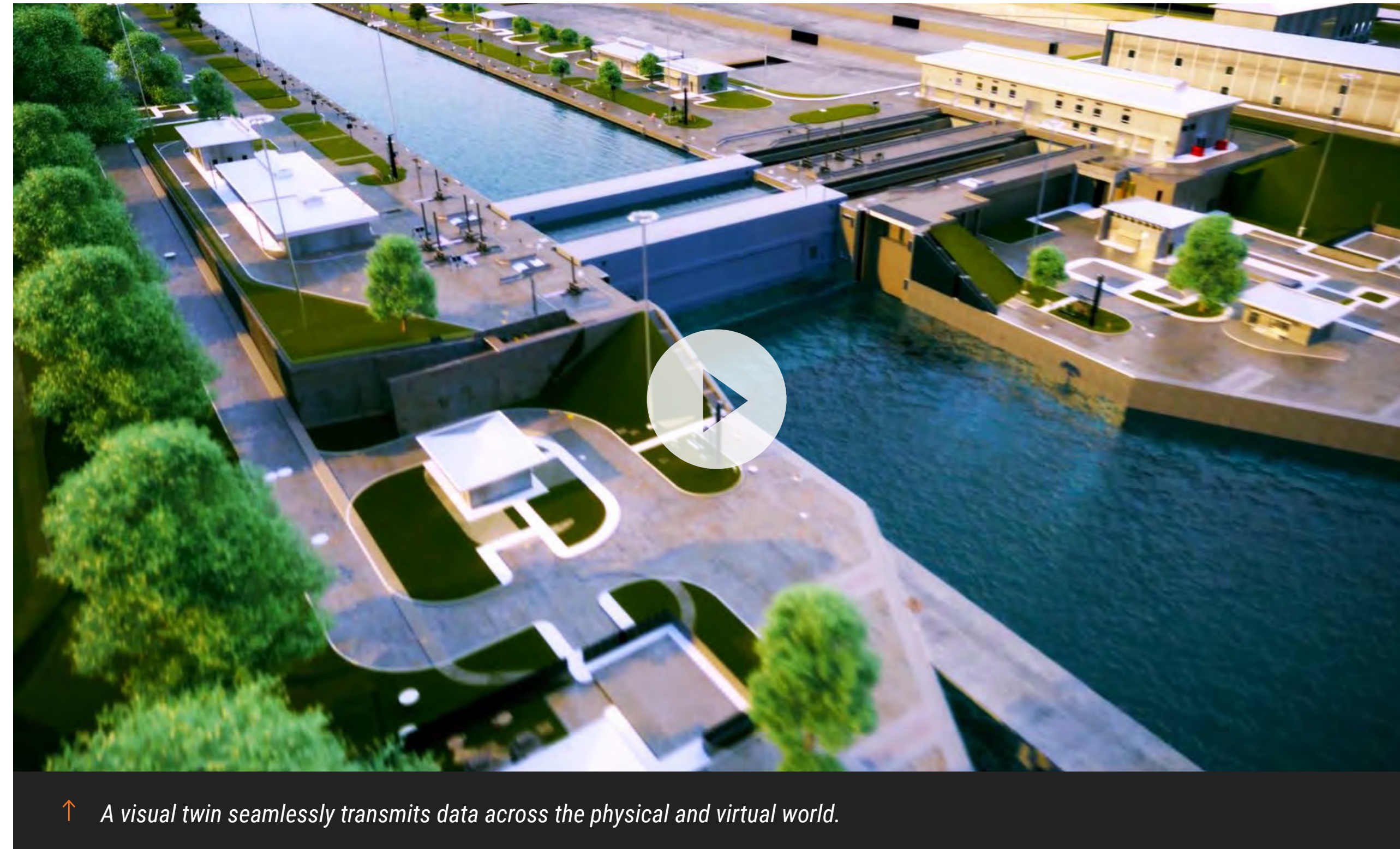
A digital twin enables teams to simulate future scenarios before, during, and after construction, resulting in improved design, constructability, and O&M.

BY GABRIEL LLORT
AND JOSEPH HUANG

In 2009, the Panama Canal Third Set of Locks project

was in early development phases. The expansion would make it possible for the canal to accommodate today's larger ships, referred to as "Post-Panamax" ships. The Third Set of Locks project includes two massive lock facilities—one on the Atlantic side and the other on the Pacific side. Each facility has three lock chambers raising and lowering ships more than 85 feet while using less water than the existing smaller locks.

The engineers, consultants, and owners working on the project knew they were a part of one of the modern marvels of the engineering world. The \$5.25 billion project would use the most advanced technology available. The project brought together a global team of experts to implement a Building Information Modeling (BIM) process. This team would ensure the design could meet the various performance requirements and operating scenarios. The process advanced the state-of-practice on many components on the project,



↑ *A visual twin seamlessly transmits data across the physical and virtual world.*

including the state of the tools used in the process.

This BIM process was used to develop a digital twin of the Panama Canal. Throughout the design, construction, and now three years of operation, this

digital twin has enabled the team to improve quality of design, increase productivity, and facilitate communication with the client, builder, and operator.

What is digital twinning?

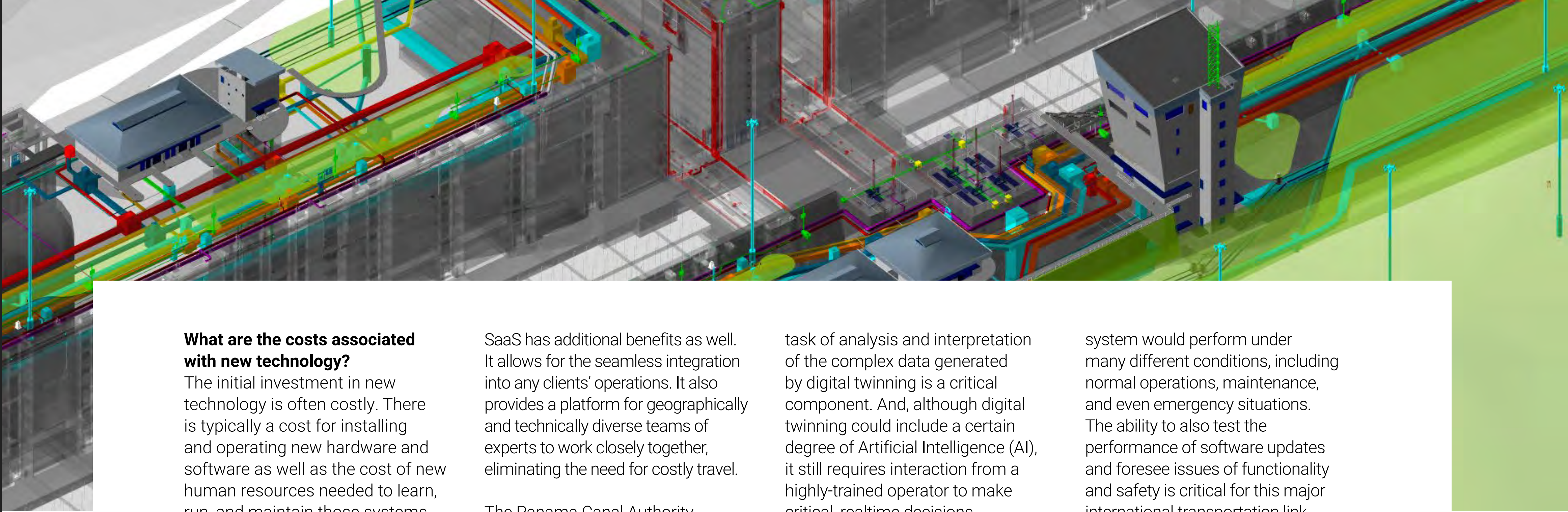
Digital twinning combines sensors,

data, and visualization software to create a digital copy of a physical entity. Once created, it seamlessly transmits that data across the physical and virtual world. The virtual entity then exists simultaneously with the physical entity. The user is essentially

creating an avatar of a complex system or mechanism before it is built or tested in a real-world environment.

The power industry has been using similar technologies for years. In the late 1980's, Stantec commissioned a computerized powerplant simulator replicating the hydroelectric plant's operation. It was designed to train operators, evaluate contingencies, develop code, and test software. The stumbling block, however, was the limited computer and data storage capabilities. The technology available at the time could not process the copious amounts of data imported from online systems.

Now this data is gathered in real-time from the physical world. This is because of greater and more cost effective computer and storage capabilities, together with a new generation of network connected sensors. It is used to create a virtual copy, which offers insight into how a mechanism or system is operating in realtime and will operate over time. >



What are the costs associated with new technology?

The initial investment in new technology is often costly. There is typically a cost for installing and operating new hardware and software as well as the cost of new human resources needed to learn, run, and maintain those systems.

The next big step for digital twinning could eliminate part of that cost. The answer is a cloud-based Software as a Service (SaaS) option. The digital twin then exists virtually. It's value and cost-effectiveness is due to the advantages brought about by simplified licensing and the elimination of the time and expense of near-constant updates and upgrades needed with traditional software and hardware.

SaaS has additional benefits as well. It allows for the seamless integration into any clients' operations. It also provides a platform for geographically and technically diverse teams of experts to work closely together, eliminating the need for costly travel.

The Panama Canal Authority overcame the high initial cost hurdle by being one of the first adopters in this kind of project scale. They made BIM process and deliverables a part of their requirements.

How can this technology help the life cycle of the project?

Once the digital twin system is put into place, it must be used and managed correctly. A successful life cycle management of any project is dependent on this. The monumental

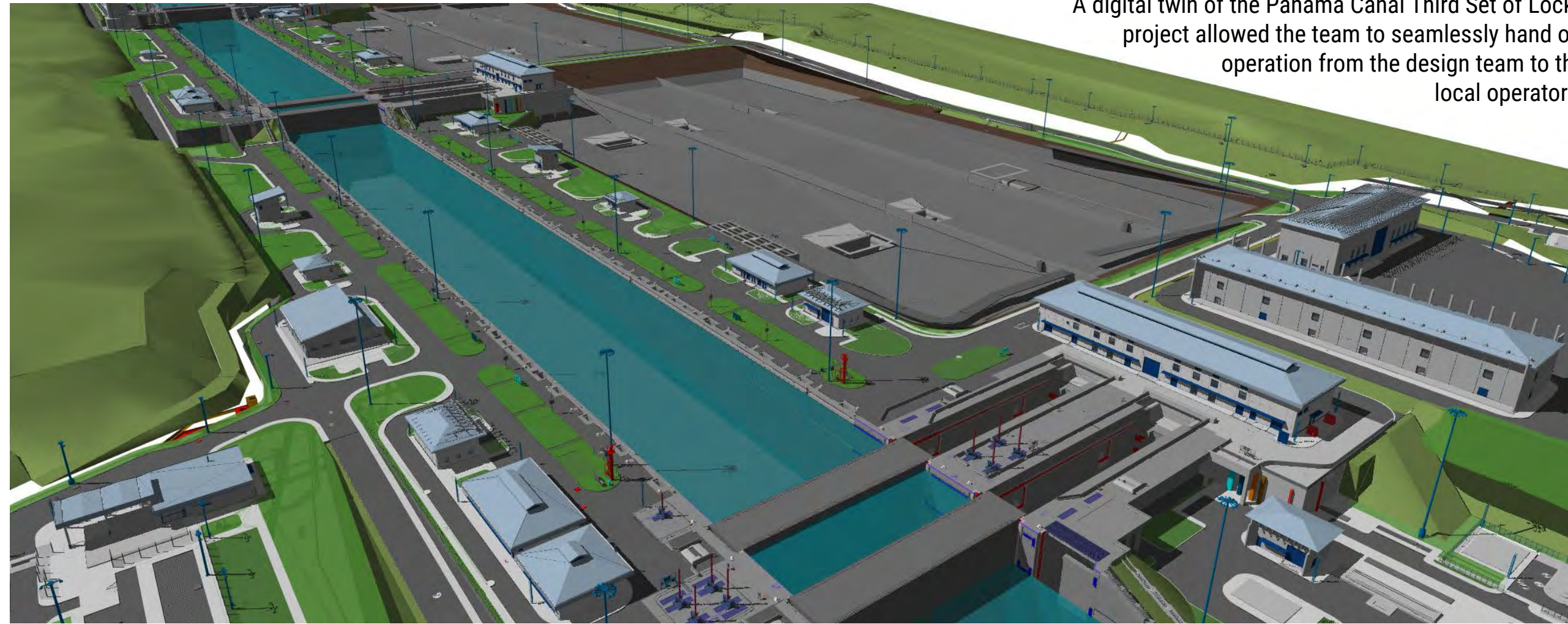
task of analysis and interpretation of the complex data generated by digital twinning is a critical component. And, although digital twinning could include a certain degree of Artificial Intelligence (AI), it still requires interaction from a highly-trained operator to make critical, realtime decisions regarding life cycle management.

During our work on the Panama Canal, engineers were able to turn over the operation of the Third Set of Locks to the Panamanian Canal Authority so that every aspect of its operation could be managed efficiently by the local operators. They are now able to extensively replicate mechanical and electrical systems and run numerous scenarios. Now they can fully understand how each

system would perform under many different conditions, including normal operations, maintenance, and even emergency situations. The ability to also test the performance of software updates and foresee issues of functionality and safety is critical for this major international transportation link.

THE GENIUS OF DIGITAL TWINNING IS THE ABILITY TO NOT ONLY DESIGN AND TEST COMPLEX SYSTEMS, BUT TO MANAGE THEM BY MANIPULATING TIME AND LOOKING INTO THE FUTURE.

With better information and better sensors, operators can make faster, more intelligent decisions. >



A digital twin of the Panama Canal Third Set of Locks project allowed the team to seamlessly hand off operation from the design team to the local operators.

What are the applications of digital twinning?

The applications for these powerful tools are endless. They are used in wind and gas turbines, power, hydro, and the mining industry. We need to take advantage of the higher quality and faster processing of high volumes of information and apply our valuable knowledge of powerplant processes and equipment.

The next big application for digital twinning is smart cities. Designing and managing smart cities will be the ultimate combination of every

industry coming together in a grand, urban setting. Since there's no way to create a 1:1 scale of an entire city, digital twinning with Virtual Reality (VR) and Augmented Reality (AR) will allow people to understand the building types, traffic patterns, public spaces, and future development of a physical city.

The future is now.

It's true that the future is now. Today, in all industries, every function of a project can be duplicated and monitored in real time. We can play with time and look ahead to see

what, if any, set of conditions would cause an unsafe situation for the system and correct for it now.

DIGITAL TWINNING IS A UNIQUELY POWERFUL TOOL THAT DELIVERS COST SAVINGS, LIFE CYCLE MANAGEMENT, AND ENDLESS APPLICATIONS.

As we branch out into the vast, exciting possibilities of digital twinning, industry professionals must be diligent to clearly understand and define the scope. ■

Gabriel Llort

Technical Practice Leader,
Power and Dams



Gabriel is an electrical technical lead and a vice president at Stantec. He has 38 years of experience automating some of the world's largest hydropower plants. He was the deputy design manager – electromechanical for the Panama Canal Expansion project.

Joseph Huang

Principal, Architect,
Power and Dams



Joseph has more than 20 years of project experience from vertical construction to large-scale water focused projects. As the BIM manager for the Panama Canal Expansion, he managed and coordinated more than 50 models across multiple offices on four different continents.

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THE ERA OF VIRTUAL & AUGMENTED REALITY



LEARN MORE
ABOUT THE PANAMA CANAL
EXPANSION PROJECT

THE ERA OF VIRTUAL & AUGMENTED REALITY



How VR and AR technology
are transforming the world
of energy and resources

BY SHANE GOOSNEY
AND JASON CARTER

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“**THE ABILITY TO, QUITE LITERALLY, SEE INTO THE FUTURE OF YOUR PROJECT IS AN INVALUABLE ASSET.**”

The energy and resources sector, and in nearly every industry in fact, is undergoing a massive transformation in the wake of increasingly widespread adoption of AR and VR technology. Its use can lead to improved communications, enhanced safety, more effective training, and increased efficiency, which in turn saves time and money. The result? A technological revolution on a scale comparable to the invention of the computer that will permanently change the way we work.

It makes us better communicators

What would you find more useful and engaging: watching a lengthy PowerPoint presentation describing a proposed project with text and images, or putting on a VR headset to review an accurate visualization of the project's end stage? The ability to, quite literally, see into the future of your project is an invaluable asset. Furthermore, you can utilize AR to send interactive, virtual 3D models to clients to facilitate real-time design reviews. The client would have the ability to spin the model 360 degrees, add comments, view specific data points, and more. This offers a fresh perspective on viewing complex data, eases the difficulties of working around language barriers, and leaves very little room for interpretation from a technical standpoint. From simply looking at the 3D model, everyone can tell exactly what it is and can see exactly where it needs to be improved. >

This technology can also lead to improved community engagement. When explaining a complex project to stakeholders who have little-to-no technical knowledge of your industry, it can often be difficult for them to understand the details by looking at flat maps and 2D graphics. Providing them with a virtual experience not only leads to better understanding, but can also generate a new level of interest by leveraging technology that people are both familiar with and enjoy using.

It can lead to enhanced safety

Safety always comes first in the energy and resources sector, especially at mine sites where it's a priority to mitigate hazards. The use of AR/VR has enormous potential to improve safety records. A VR simulation can replicate a mine showing potentially hazardous environments and situations. Employees could then be trained on how to handle these incidents entirely from the safety of an office. The system can be programmed to walk the employee through all the necessary steps for each specific situation and if they skip a step, the system would prompt them to go back and try again. This same process can be used to train employees on how to operate heavy equipment before having to step foot out into the field. Studies have shown that immersive virtual learning experiences are entirely more memorable and effective than simply watching a training video.

What's really the difference?



VIRTUAL REALITY



Virtual reality replaces the real world with a simulation. VR headsets are designed to provide a totally immersive experience by blocking out your natural surroundings and manipulating your senses to transport you to a different environment.

vs. AUGMENTED REALITY



Augmented reality keeps you in the real world while bringing virtual elements into your environment. This can be done in two different ways, through AR glasses or by using a smart device, both of which project a hologram that appears in the space.

Additionally, AR lenses can be attached to hardhats and used by onsite workers to scan their environments and display real-time data right in front of their eyes. This is especially useful in situations with limited visibility. The AR glasses can identify objects and potential hazards in front of the user or assist them in finding their way out of a mine or tunnel.

The technology is more accessible than you might think

There are several different VR and AR devices in today's market, spanning a large range of prices, that provide differing levels of immersion, graphics quality, and mobility. Of course, price and quality often go together, but it's worth noting that prices will drop as this technology becomes more mainstream and as the market becomes saturated with competitors. In fact, some of the more high-end devices are already on a [downward pricing trend](#)¹.

Regarding ease of use, there is software available that can do most of the hard work for you, in terms of converting designs into 3D models. Essentially, you can upload a drawing into a software application and let the computer perform all the difficult rendering.

The ability to go more in-depth and add striking visuals or animations are also options. >



“THE GLOBAL VR/AR MARKET IS EXPECTED TO BE WORTH MORE THAN \$94 BILLION BY 2023.”

Once this technology becomes integrated into your workflow and included as part of your budget, the cost becomes an afterthought compared to the value added. When you consider the savings resulting from reduced approval times, utilizing virtual models rather than sending employees and investors to the project site, and reducing the number of onsite accidents by conducting virtual trainings, it’s reasonable to say that VR/AR pays for itself in the long run.

This technology is here to stay

The VR/AR revolution is not going to happen—it’s currently happening. Businesses around the world are already taking full advantage of this technology to improve the way people live and work. And this won’t be just a passing trend. The global VR/AR market is expected to be worth more than \$94 billion

by 2023². Most experts agree that one day it will become so mainstream, we will wonder how we ever got along without it, similar to how we now view our smartphones.

Wondering how you can keep up with the latest trends? The simplest answer is to actively pay attention. Watch television, listen to the radio, talk to peers, and scour the news to learn about the market. Also, don’t hesitate to look outside your own industry to discover innovative ways to use AR and VR. See what others are doing and tailor their practices to fit your needs. This technology is constantly evolving, and, as it continues to find its footing in the world of energy and resources, the best time to begin familiarizing yourself with it and taking steps to incorporate it into your business is now; you may soon find that you can’t afford to wait. ■

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Jason Carter

CAD Systems Specialist, Oil & Gas



With more than 20 years of experience and a background in pipeline design, Jason is responsible for providing CAD support for multiple design disciplines. Currently, he is focused on advancing the use of technology in the oil and gas realm to improve design, project delivery, and safety standards.

Shane Goosney

Senior Project Specialist, Mining



Shane has a diverse background in engineering and visualization technology, including BIM, 3D design, animation, and virtual and mixed reality applications. His 30-year career has taken him around the globe to deliver complex design projects within the mining sector.

If you like this article, you might be interested in: **EMBRACING A NEW EDNA TECHNOLOGY**



LEARN MORE ABOUT DIGITAL REALITY

eDNA

We can deliver power and keep rare species safe

Conventional methods of observing and detecting aquatic species can be time consuming, expensive, and harmful. Using eDNA sampling, we can perform non-invasive surveys for the presence of these creatures—potentially saving your projects time and money.

BY JAKE RILEY

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Embracing a new eDNA technology

Energy and mining markets are committed to delivering necessary power, energy storage, and raw resources to their communities. Without proper planning, these projects can negatively affect the very communities they are attempting to serve. New technology delivers tools that enable clients to detect rare species faster to help projects meet regulatory requirements.

All living organisms expel genetic material into their environment. We call this matter environmental DNA (eDNA). When it comes to fish and other aquatic species, eDNA is shed through the skin, scales, and waste into the water they inhabit. By sampling the water and analyzing this eDNA, we can detect the presence of a species we're specifically looking for.

Right now, our planet is facing a biodiversity challenge and some tough realities with regards to rare and endangered species. Globally, countless numbers of plant and animal species face extinction. Populations of some living organisms have declined at an alarming rate.

By monitoring these animals, we help design projects that reduce and avoid impacts to these species. >



THE LOCATION OF IMPORTANT
RENEWABLE ENERGY PROJECTS
LIKE OFFSHORE WIND MILLS
COULD IMPACT AQUATIC LIFE.
eDNA CAN HELP US DETECT WHAT
WILDLIFE IS PRESENT AND ADJUST
OUR DESIGNS TO PROTECT THESE
IMPORTANT SPECIES.



↑ eDNA was used to detect and protect marine life at risk in the Bay of Fundy.

A progressive technology

Conventional methods for detecting aquatic species can take a long time, are expensive, and can harm the target species and their habitat. This is where new eDNA technology provides an advantage.

We are deploying the latest tools to sample, extract, and analyze eDNA to detect the presence of target species in the field. These tools allow us to produce accurate and rapid results, in real time. And now,

instead of waiting for eDNA test results to come back from a lab, we can get results in the field—in less than two hours. Quick turnaround means projects can address permitting issues faster.

We also partner with eDNA labs. These partnerships give us access to the latest tools to deliver eDNA results where and when it is needed, which results in projects staying on track. >

“**KNOWING THE ENVIRONMENT YOU ARE WORKING IN IS ESSENTIAL AT EVERY STAGE OF A PROJECT.”**



eDNA has proven reliable at detecting rare species at low densities, which helps us in cases where we're searching for species that are hard to find. The method is also advantageous because, compared with conventional methods, sampling for eDNA is:

- more sensitive
- cost-effective
- safer for both species and field staff
- less harmful to environment
- more objective for identifying species



Results from the field

Through our lab partnerships, we can test for more than 60 species using eDNA technology, and the species list is growing. Notable studies thus far include the Jefferson salamander, an endangered species in Ontario, and the Atlantic salmon, whose status is endangered in the US and Canada.

In 2017, we tested 10 sites for the Jefferson salamander. Nine out of 10 test sites confirmed historical data of species presence or absence, based on visual surveys in early spring. However, eDNA testing at one site showed that Jefferson salamander was present when past visual surveys indicated that it was absent.

Similarly, we sampled five stream sites for Atlantic salmon in 2018 using eDNA. We didn't detect Atlantic salmon in the streams; however, we did detect eDNA downstream from our

positive field control—a single caged Atlantic salmon—confirming that the tools were working.

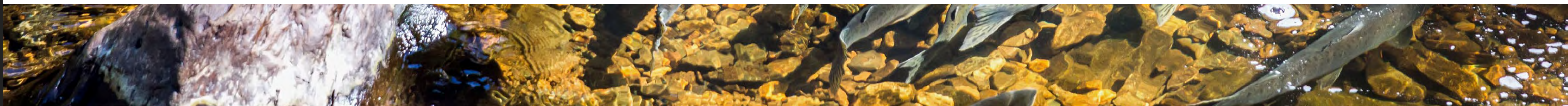
Our work has shown that eDNA is delivering on its promise as a fast, cost-effective, sensitive tool for detecting the presence of rare, threatened, and endangered species at low densities in the environment. We have also used eDNA to track invasive species so our clients could plan ahead.

Knowing means better designs

Knowing the environment you are working in is crucial at every stage of a project. In the early design phase, it is essential to get quick, accurate results. The results affect the timeline for the design team.

eDNA could be used for scouting out sites for offshore winds or looking at different locations for onshore power lines. >

**BY KNOWING WHAT
SPECIES ARE LIVING
IN A SUGGESTED
DESIGN AREA
FASTER AND MORE
CONFIDENTLY, WE
ARE HELPING OUR
CLIENTS MEET
REGULATORY
REQUIREMENTS.**





OUR GOAL?

Help our clients meet their regulatory requirements effectively and efficiently while reducing costs and avoiding harmful impacts to rare species.

Heading forward

We are moving ahead with more applications of eDNA in the field to address client questions. We are learning, adapting, and embracing eDNA tools to provide reliable services on the presence of rare species in the field. We are using and planning for eDNA tools to detect shortnose sturgeon, bull trout, Arctic grayling, burbot, and striped bass. We're also exploring uses for terrestrial ecosystems, including bats. Our team is excited to continue developing tests for other species to expand overall use of eDNA tools for detection of species. ■

Jake Riley

Senior Associate,
Environmental Services



Jake is a New England sector lead, project manager, and certified ecologist with more than 16 years of experience in endangered freshwater aquatic species and fish habitats. As part of the environment services team, he brings scientific expertise to develop solutions that meet both project goals and agency requirements.

If you like this article, you might be interested in:
CHANGING HOW FIELD REPORTS ARE CREATED



LEARN MORE
ABOUT eDNA

Changing Field Reporting through Technology

New technology is making it possible for teams to capture field reports in realtime, ensuring consistency.

BY CHRIS JORSTAD AND ROSS POULIN

In the energy and resources market, profits are made on the margins. The experts in the field are tasked with maintaining the delicate balance between schedule, cost, and quality all while collecting, storing, and reporting a significant amount of information. In this increasingly competitive market, technology in the field is the needed differentiator.

Field personnel spend long days tracking and monitoring the progress of their projects. They are continuously collecting data and checking for quality issues. All this information must be brought together accurately and efficiently at the end of each day. As the project meets milestones, it must then be made into reports for both internal and external clients. By introducing technology in the field, the process from data collection to reporting is streamlined, resulting in shorter turnaround and more accurate results.

Stantec teams across the energy and resources market are using a suite of proprietary software applications called mTOOLS™ to facilitate the information gathering, analysis, and reporting processes. By collecting data in the field using iPads, they are streamlining their work process. Our experts have pinpointed **6 ways technology is enhancing project delivery for energy and resources clients.** >

Technology creates consistency

Technology on the job site ensures all staff are on the same page, regardless of an individual's familiarity with a project. Teams can enter information into standardized forms, which are tailored to the specific needs of the project, guiding users through the process and driving consistency. These uniform layouts within the data collection and reports make it easier to understand the information being presented.

Technology makes work easier

Technology on the job site helps simplify the data collection process. By having a centralized system, team members can take pictures, track scannable materials (like barcodes on the pipes), and drop pin locations to show where work is being performed/monitored. While working in the elements, teams can use voice to text technology to record information which has been invaluable during field operations in our cold winter months. Most importantly, all of this can be done in the field, on or offline.



General Information	
Project Name:	Date:
Project Number:	Project Location (city):
Project Location (state):	Description of Work:
HAS/RMST reviewed with staff on site	<input type="checkbox"/> Yes <input type="checkbox"/> No
Review of STOP Work Authority with staff and subs	<input type="checkbox"/> Yes <input type="checkbox"/> No
Emergency plan adequate and communicated	<input type="checkbox"/> Yes <input type="checkbox"/> No
Tools and appropriate PPE inspected before use	<input type="checkbox"/> Yes <input type="checkbox"/> No
Last Minute Risk Assessment process reviewed	<input type="checkbox"/> Yes <input type="checkbox"/> No
If the answer to any of the questions above is not YES Stop work and contact your supervisor.	
Field crews have certifications on site	<input type="checkbox"/> Yes <input type="checkbox"/> No (Applicable)
Utility locations on site are understood	<input type="checkbox"/> Yes <input type="checkbox"/> No (Applicable)

“
IN THIS INCREASINGLY
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Technology encourages collaboration

Technology on the job site ensures data is available to the entire team. Large projects have multiple moving parts: internal and external stakeholders, and multiple systems and processes. By having a centralized location for all collected data, team members across offices can access information in next to real-time. Up-to-date information ensures projects stay on track and enable project managers to monitor changing aspects of their project.

Technology reduces labor overages

Technology can make a job easier and more enjoyable. While long days in the field are still a reality, overtime can be significantly reduced using technology to deliver workflow automation.

Teams can arrive on-site with access to all the necessary information, ensuring tasks can be completed efficiently.

Because data is captured in real-time in the field, extra hours for reporting are virtually eliminated. Field reports are created and distributed immediately, instantly updating all associated data on customized dashboards.

“
BECAUSE DATA
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Technology increases accuracy

Technology in the field provides more accurate and timely results. By avoiding handwritten field reports, teams reduce inaccuracies that are sometimes caused by duplicating efforts.

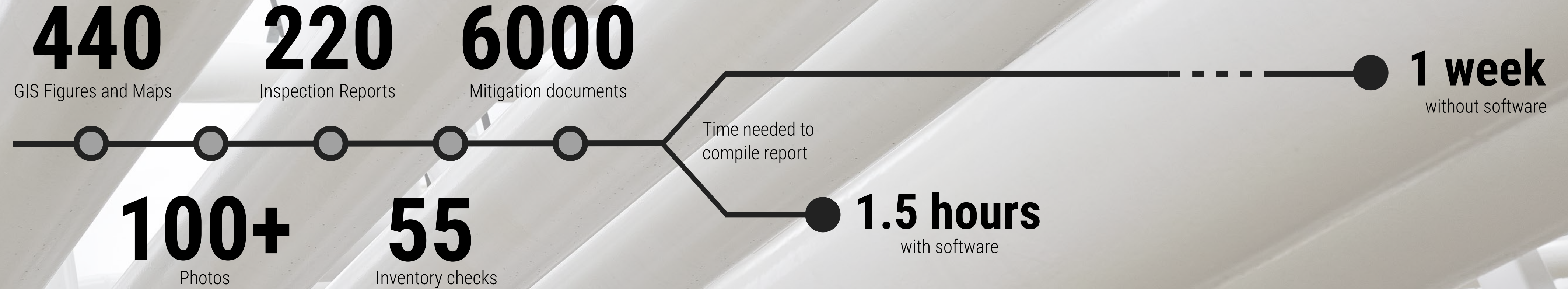
When outliers arise, software platforms like Stantec's mTOOLS™ can rapidly create reports from the data allowing teams to investigate quickly. Dashboards can also be developed allowing users to analyze their data and provide useful information, which can assist in making better business decisions.

Technology simplifies reporting

Technology makes the creation of final reports easier. The reports are easily published with rich photographs and informative charts. By using a centralized database, teams can create templated reports that already includes boiler-plate text. This makes client-focused outputs easier to template and populate.



STATISTICS FROM A TYPICAL OIL AND GAS PROJECT



USING TECHNOLOGY THROUGHOUT RESULTS IN LONG-TERM SOLUTIONS THAT ENSURE CONSISTENCY, QUALITY, ACCURACY, AND COST SAVINGS FOR OUR CLIENTS.

Field staff are now able to use their skill sets to improve institutional knowledge, address issues earlier, and solve problems all within one centralized application. Less effort is being spent on time consuming data collection allowing them to focus on delivering projects.

In an industry that makes its money on the margins, technology makes the difference! ■

Chris Jorstad

Project Systems Support,
Oil & Gas



As an oil and gas systems support supervisor, Chris is responsible for developing and supporting computer applications and processes. With more than 30 years of experiences in operations and field work, Chris is focused on meeting the challenges of the user community and translating these requirements to software developers.

Ross Poulin

Managing Consultant

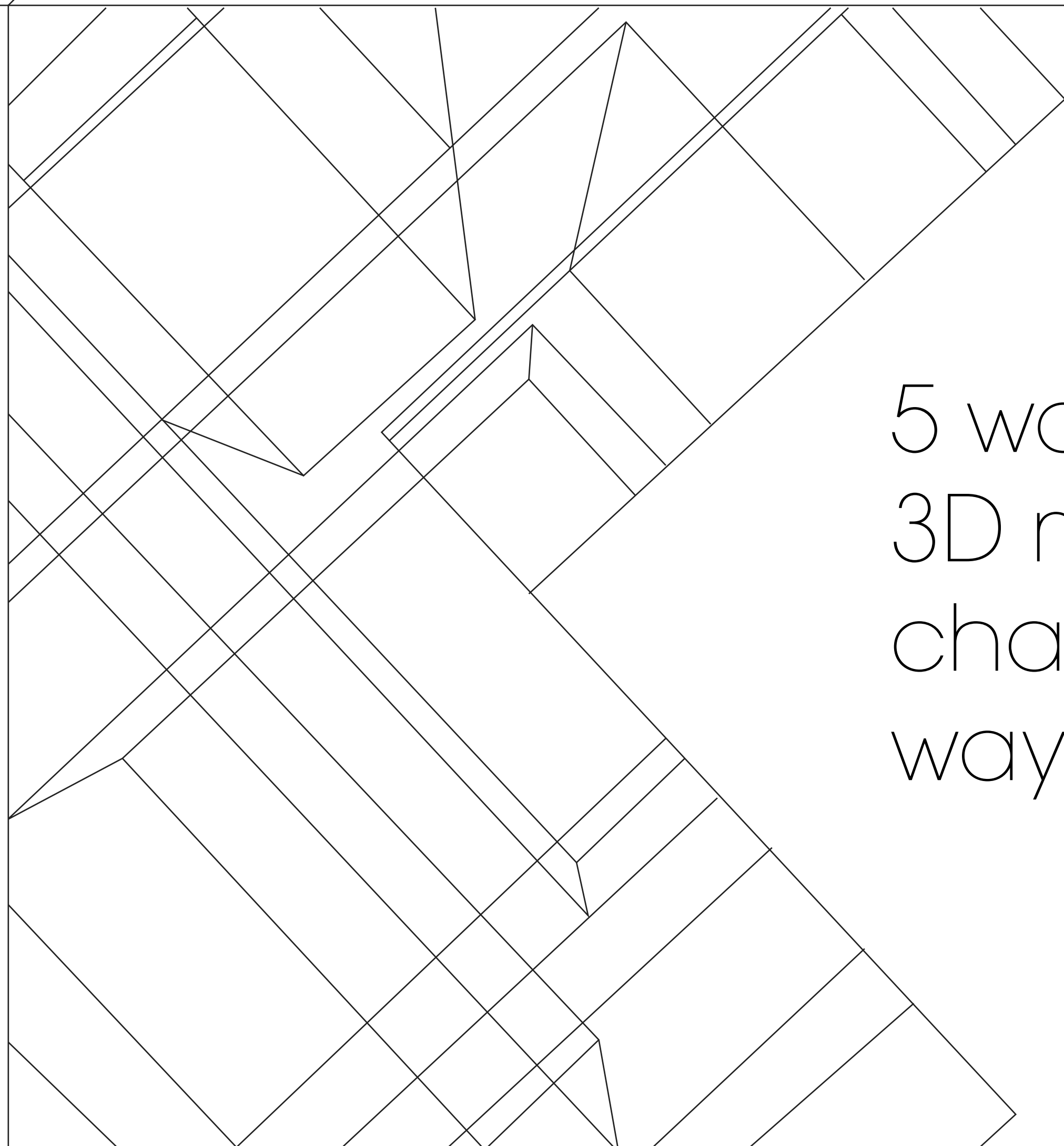


Ross specializes in the implementation of innovative, client-centered, analytical frameworks that improve a client's strategic planning and business performance. He uses a combination of commercial, off-the-shelf products and mTOOLS™, Stantec's suite of proprietary data collection, analytic, and reporting tools.

If you like this article, you might be interested in:
5 WAYS 3D MODELING IS CHANGING THE WAY WE DESIGN



LEARN MORE
ABOUT mTOOLS™



5 ways 3D modeling is changing the way we design

A design revolution is on the horizon in the power industry. Since the 1970s, computer-aided drafting (CAD) of power substations has been almost exclusively used in the utility industry to design physical substations. But now, three-dimensional (3D) modeling is changing everything.

Designing in 3D simplifies the engineering process by using new software that enables teams to develop an integrated design. Here are five ways this new design approach is changing the industry. >

BY ARIELLE KADOCH

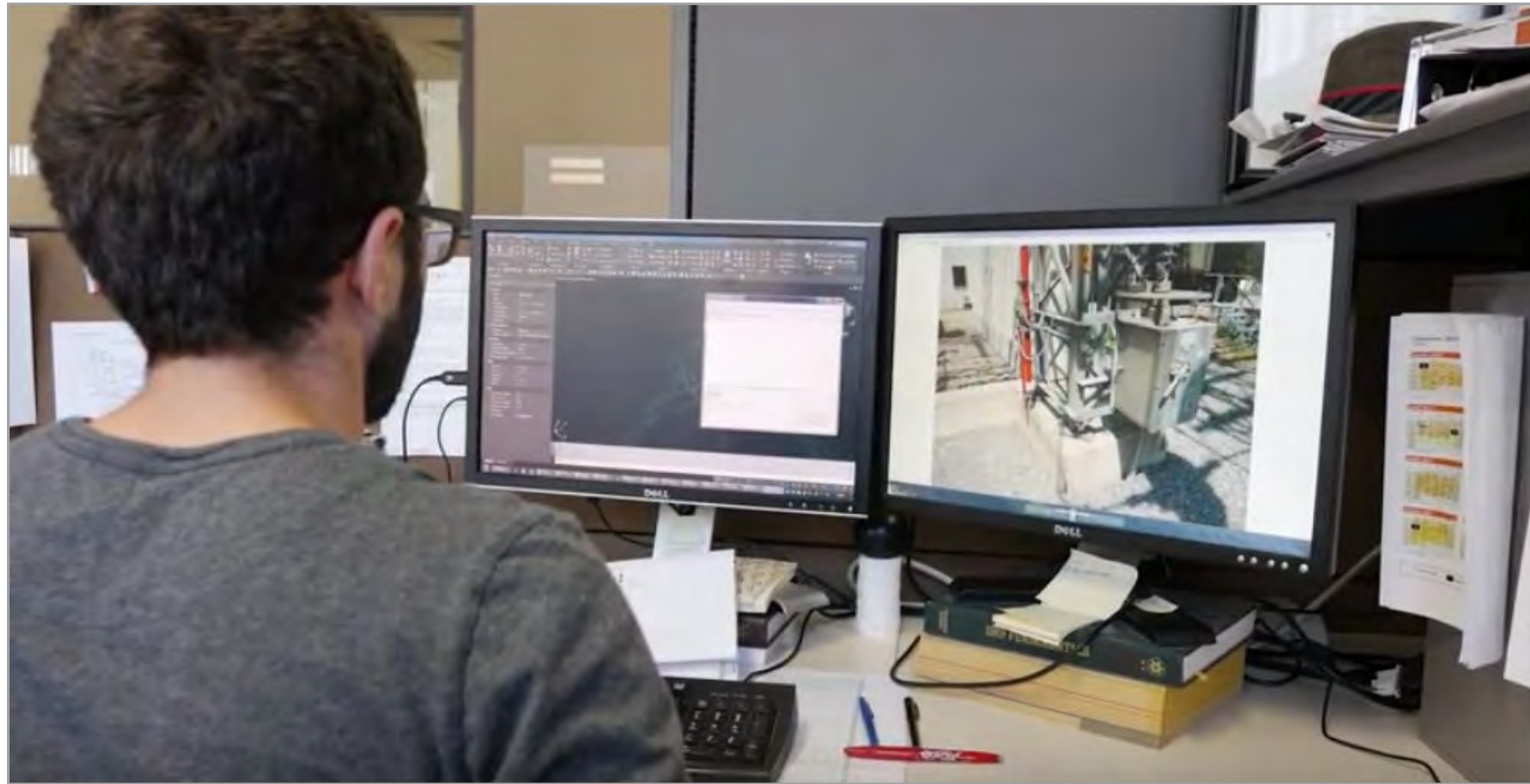
1 IMPROVES QUALITY AND ACCURACY OF DESIGNS

Designing in 3D limits the risk of design errors. This is because 3D design provides automatic calculations and validations for electrical clearances of equipment, quantities of materials, and the modification of equipment arrangements. By modifying equipment arrangements, we can adapt the design requirements to the site and optimize the design. Other modifications, such as replacing types of equipment, are also quickly and easily accomplished by avoiding additional risk of errors.

3D modeling software also allows us to ensure our models are spatially correct. This includes connectivity between components, such as materials, engineering properties, and physical details. All this data is linked to a design database and functional design documents such as one line diagrams. This provides us with the information required to automate the extraction of drawings, schedules, and cost estimates—leaving little room for error. >



↑ *New technology is changing the power industry and how projects are designed and delivered to clients.*

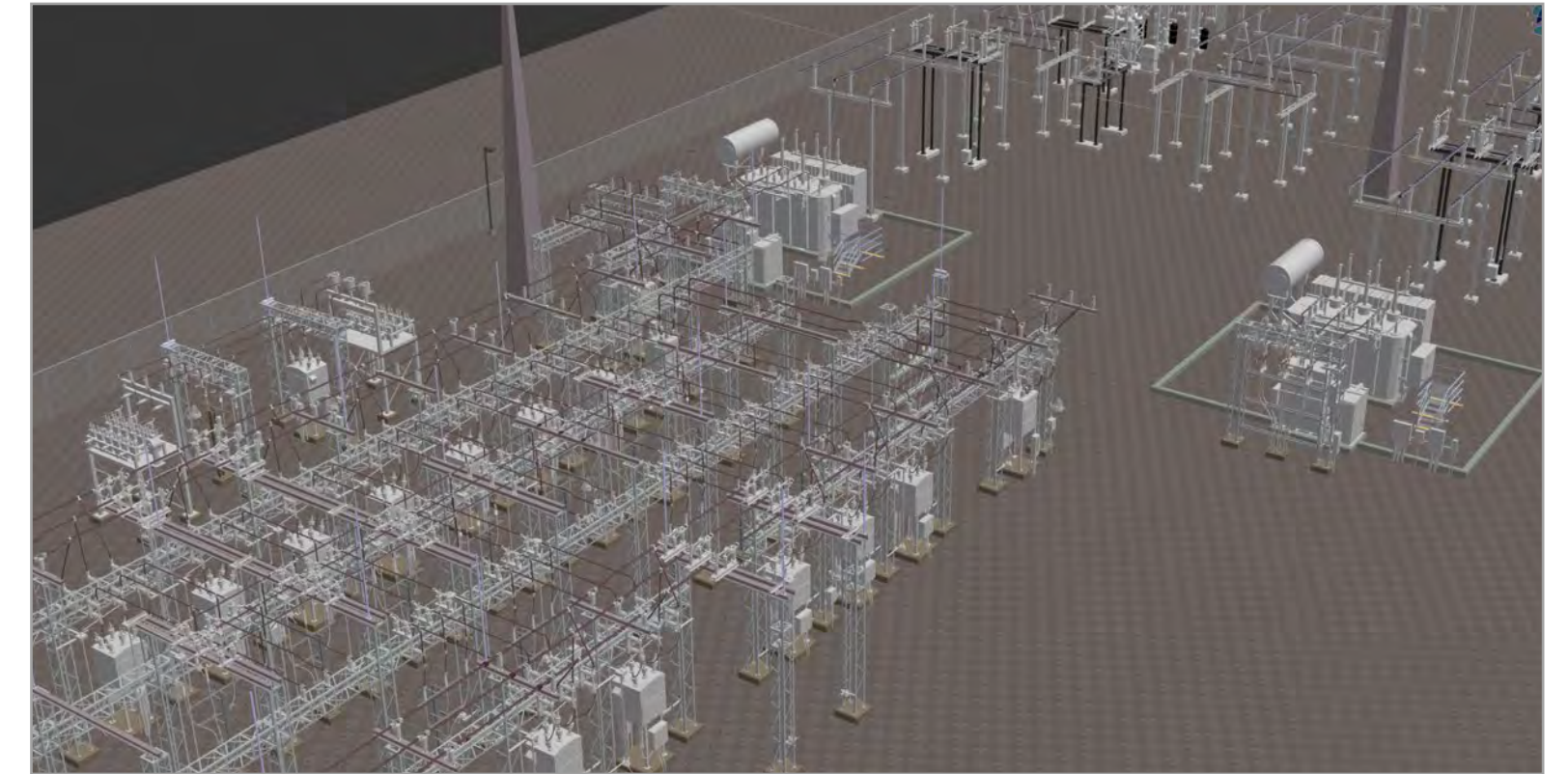


2 IMPROVES SCHEDULES AND TURN-AROUND-TIME

It can take a couple of engineers four to six months to design a simple distribution substation in the traditional method. The more complex substation designs become, the more time consuming they are. Skilled designers spend their time at CAD workstations manually making detailed construction drawings one line at a time. After the design is created, it must then be reviewed, and the quality processes must be considered.

Automating substation designs has proven to reduce time significantly. From a 3D model, accurate design drawings, material quantities, and equipment data can be extracted in a fraction of time. 3D models are shown to contractors to help save significant time in the construction process as well. The efficiency and planning benefits are also important, as is the expedited process of acquiring necessary permits.

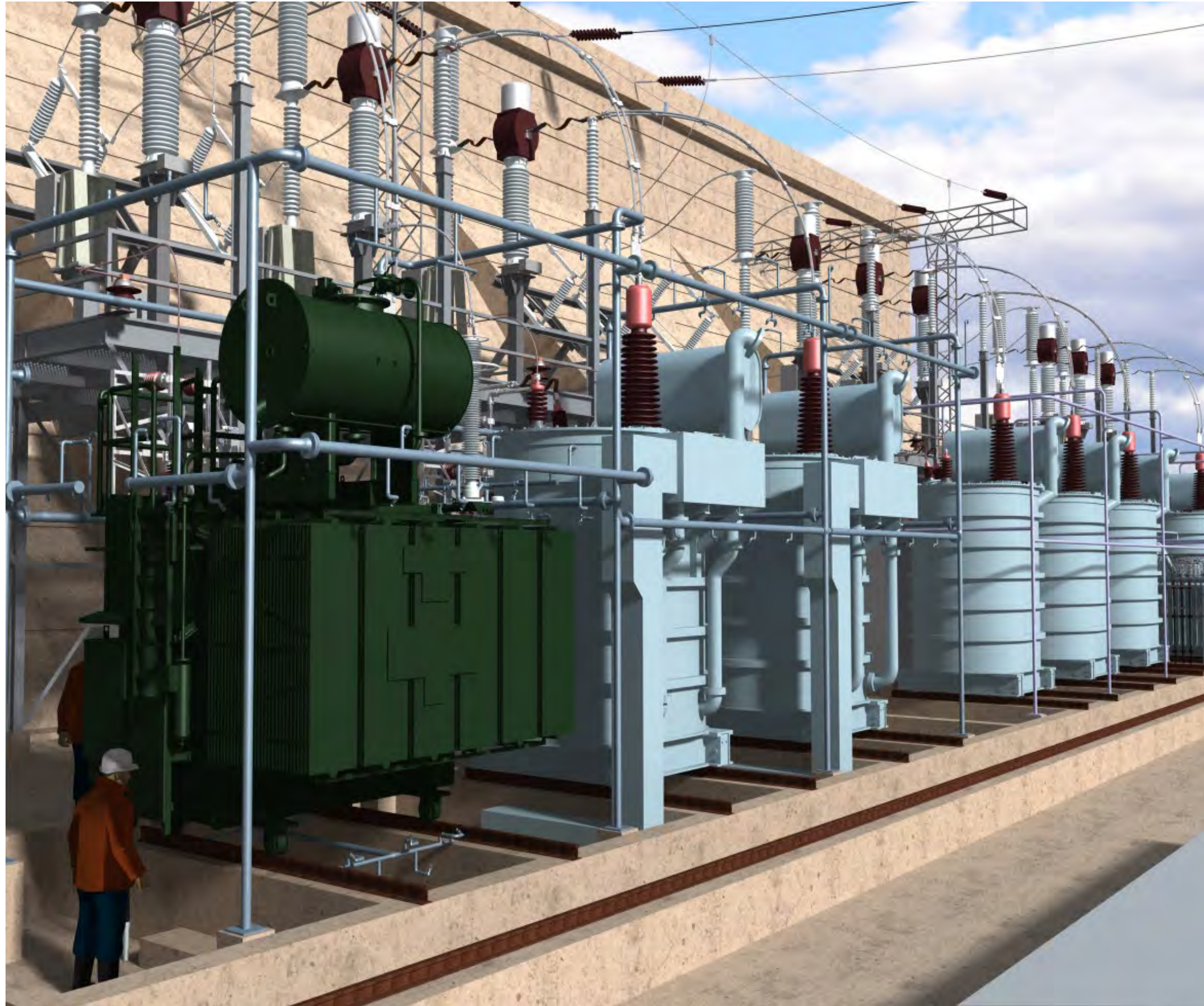
**THE BENEFITS
OF 3D
MODELS ARE
UNDENIABLE.
IT CREATES A
MORE COMPLETE
PICTURE OF A
PROJECT AND
SERVES TO
BENEFIT BOTH
THE ENGINEER
AND THE CLIENT.**



3 RESULTS IN COST SAVINGS

Reduced schedule has a direct impact on cost. Automated designs, which generate a bill of materials and eliminates any discrepancy between deliverables, have significantly reduced the cost of projects. Very quick estimates of the cost and feasibility of projects at early stages or for the construction phase have proven to be accurate and beneficial.

Further cost benefits related to changes within a 3D model design are also much less. Designers can identify design issues earlier and avoid additional costs linked to redesigns. >



4 GREAT FOR VISUALIZATION

3D designs have changed the way projects are presented. 3D software is making walkthroughs for design, construction, commissioning, operations, and maintenance much easier.

The 3D design makes it simpler for clients to visualize dimensions, space, clearances, movement, and access. The design is incredibly realistic and provides details about each element. This results in fewer surprises down the road. During the design phase, it facilitates interdisciplinary coordination by allowing each stakeholder to visualize the interferences and dimensions of the equipment.

The fact that different design options can be plugged into the model to test potential scenarios has helped confirm decisions and identify problems early on. It is easier to change a project during the design stage rather than after construction has begun.

A well-designed 3D model can guide your construction design process from the beginning to the end. It can also be a crucial marketing piece for a firm or a client by allowing clients to see their project and get excited. >

5 REUSABILITY OF DESIGNS BY CREATING DESIGN STANDARDS

3D modeling is a tool that can make future projects easier to design. Once equipment libraries are created according to client standards or from manufacturer information within a 3D software, new designs can be easily created or modified. Libraries created within a software can often be reused as a placeholder on a different, compatible 3D software, but will need to be adapted for parametric performance and to incorporate intelligence.

For example, once a 3D substation model is created within 3D software, it can be saved as a standardized design and reused on future projects. When a new design is required, the saved relevant template can be used as a quick starting point, and then modified for site-specific requirements. You can then easily create the design deliverables, and as the library content increases in size and component types, the overall modeling time will decrease. The goal is to automate the process of creating both standardized designs for reuse and unique designs based on advanced 3D modeling techniques.

Within the 3D modeling software, unique designs can be created from scratch or designs can be incorporated from other substation models. 3D models can also be used to create 2D drawings.



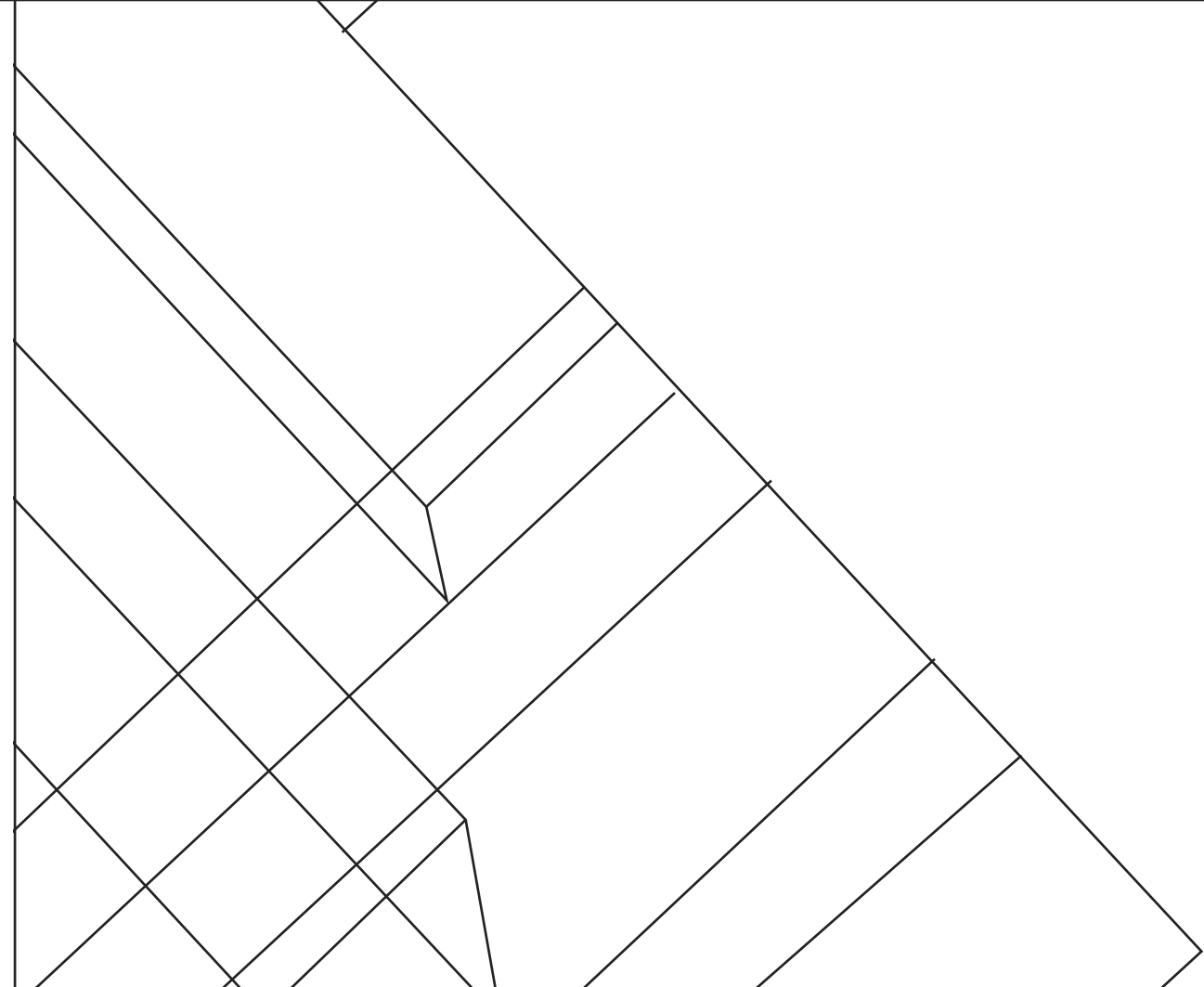
Of course, a large percentage of existing substations were built over 50 years ago, and detailed drawings of the stations may be outdated, incomplete, or even unavailable. Terrestrial LiDAR, a laser scanning tool, has proven to be an excellent tool for substation expansion projects. It can provide a comprehensive survey of all equipment, structures, foundations bus work, and lines in a substation. In a few hours, technicians can take laser snapshots of the substation and the LiDAR 3D model (data cloud) can serve as a virtual substation on the engineer's computer. The model can be incorporated in a 3D software and rendered into a complete set of detailed as built drawings for the substation in only a few weeks. >



UNDENIABLE BENEFITS

The benefits of using 3D models are undeniable. By providing a strong visualization of the project, clients and stakeholders will be more easily convinced of its complexity and significance. 3D creates a more complete picture of a project and serves to benefit both the engineer and the client.

It's time for the utility industry to rethink substation design strategies. A new generation of power delivery systems design and engineering is coming. ■



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¹ Downward pricing trend

² \$94 billion by 2023